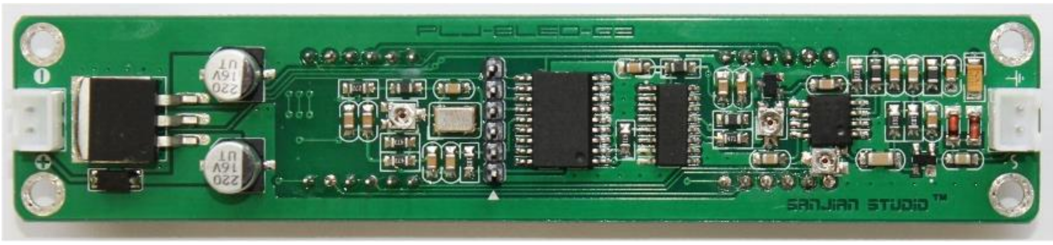
8-digit LED Frequency Counter Module

Model PLJ-8LED-C





User Manual V 1.0

SANJIAN STUDIO™

May 2014

Appendix with test details and schematics and additional notes in the main text of this manual were added in August 2016 by ZL2PD.

CONTENTS

OVERVIEW

The PLJ-8LED-C module is a cost-effective 8-digit frequency counter and display module primarily to display the operating frequency in a transceiver and other equipment. It may also be used for conventional frequency measurement. The module offers compact, reliable high performance with clear display at low cost.

The main features include:

- Microchip PIC16F648A forms the core of the 2.4GHz frequency meter.
- Frequency reference using a temperature-compensated voltage controlled crystal oscillator (2.5 ppm VC-TCXO).
- Unique gate control with precise time algorithm (No timer interrupt).
- Gate (display refresh) times include 0.01, 0.1 and 1.0 seconds to allow a real-time frequency display.
- Single connector input design supports three frequency measurement modes (Low channel / High channel / Auto mode).
- Dual mode IF modes allow the offset value and the IF up / down mode to be separately preset.
- Eight 0.56 inch high brightness LED digits with adjustable brightness.
- Automatic leading zero blanking, invalid display filter frequency selectable, optional last bit blanking.
- Elegant circuit design supports two-button control for simple operation.
- Settings are saved automatically and directly recalled at power-up.

TECHNICAL SPECIFICATIONS

1. GATE TIME

- 0.01 sec
- 0.10 sec
- 1.0 sec

2. CHANNEL MEASUREMENT PERFORMANCE (CHANNEL LEVEL HIGH IMPEDANCE)

Low channel

Measuring range: 0.1 MHz - 60 MHz

Accuracy: ± 100Hz (0.01 sec gate time)

± 10Hz (0.1 sec gate time)

± 1Hz (1.0 sec gate time)

Low channel sensitivity:

0.1 MHz - 10 MHz: Better than 60mVpp

10 MHz - 60 MHz: Better than 60mVpp

60 MHz - 75 MHz: Not specified

High channel (Divide by 64)

Measuring range: 20 MHz - 2.4 GHz

Accuracy: ± 6400Hz (0.01 sec gate time)

± 640Hz (0.1 sec gate time)

± 64Hz (1.0 sec gate time)

High channel sensitivity:

20 MHz - 30 MHz: Better than 100mVpp

30 MHz - 60 MHz: Better than 50mVpp

60 MHz - 2.4GHz: Not specified

Auto Channel

Depending on the frequency of the input signal, the counter will automatically select the high or low channel (Change occurs at 60 MHz). If the input signal is greater than 60 MHz but a weak signal level prevents automatic high channel selection, it is possible to manually select the high frequency channel.

3. IF SETTINGS

Independent double-IF design allows the IF settings to be adjusted in minimum increments of 100 Hz.

- Intermediate frequency range: 0 - 99.9999 MHz
- Offset: Plus or minus IF mode can be configured

4. FREQUENCY REFERENCE

13.000MHz temperature compensated voltage controlled crystal oscillator (VC-TCXO) in 5032 package

- Frequency stability: ± 2.5 ppm

5. SUPPLY

DC Input: 9V - 15V (Reverse polarity protection)

Current: 160 mA max (Test conditions: 12VDC supply, red LED display, brightness=8)

6. DISPLAY

Readout: Eight 7-segment LED digits.

Brightness: Eight LED brightness levels, factory set to maximum brightness.

7. PHYSICAL

Dimensions (L×W×H): 125.5 mm × 25.5 mm × 21.5 mm

Weight: 46 g (net weight)

8. INTERFACES

DC IN (Power Interface): HX2.54-2P socket

RF IN (signal input): HX2.54-2P socket

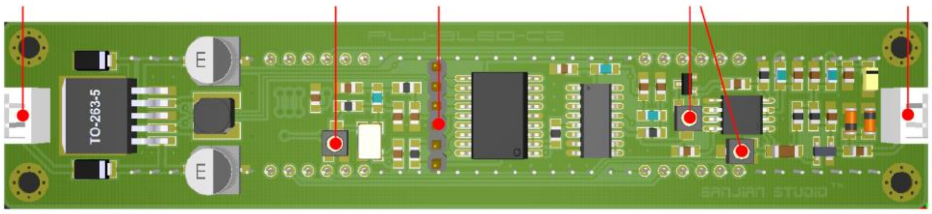
ICSP (programming interface): 2.54-6P Pin

OPERATION AND USE

1. MODULE ARRANGEMENT



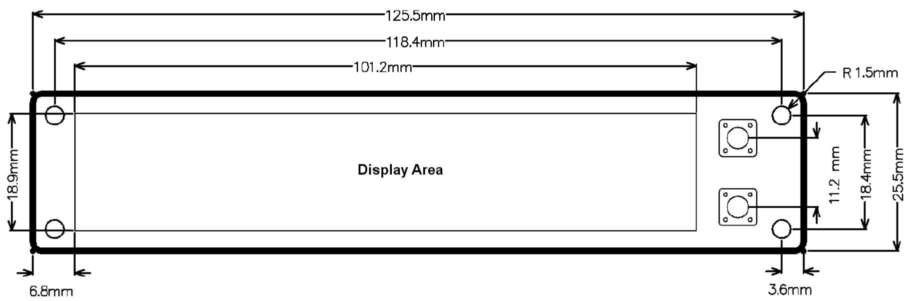
Front view of module



Rear view of module

Note: This diagram shows the High channel (Ch H) components on the right hand end of the board. The Low channel components are located on the other side of the PCB under the LED display.

2. MOUNTING DIMENSIONS



3. USING THE MODULE

(A) PREPARATION

1. Please check the power supply voltage (DC 9V-15V) and confirm the power supply polarity before use. The power supply circuit in the module has a series diode fitted to prevent operation when the power supply is inadvertently connected with reverse polarity. This protects the module from devastating consequences.

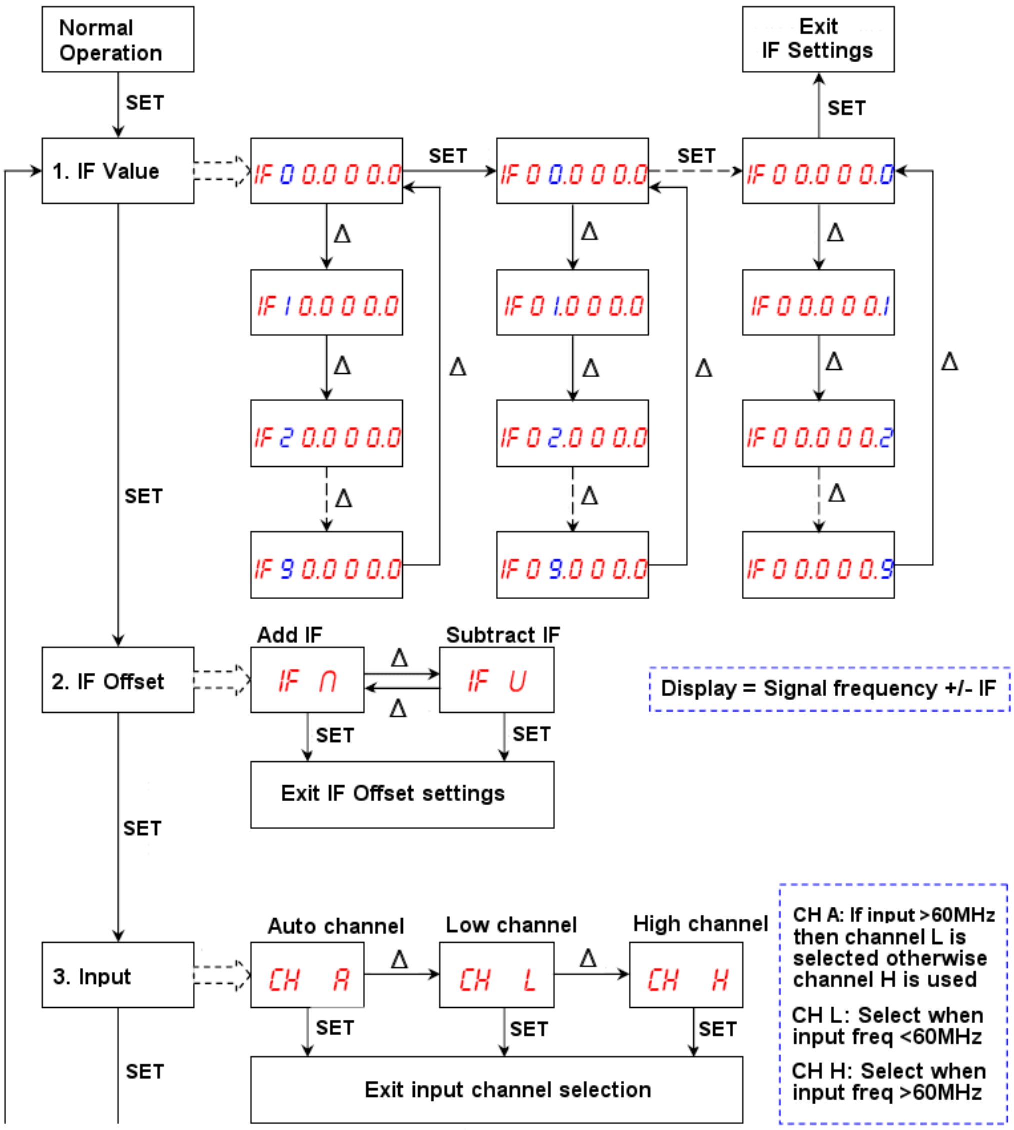
2. The signal input (2-pin) port may be connected directly to the measured signal (wired) or to an antenna (inductive mode).

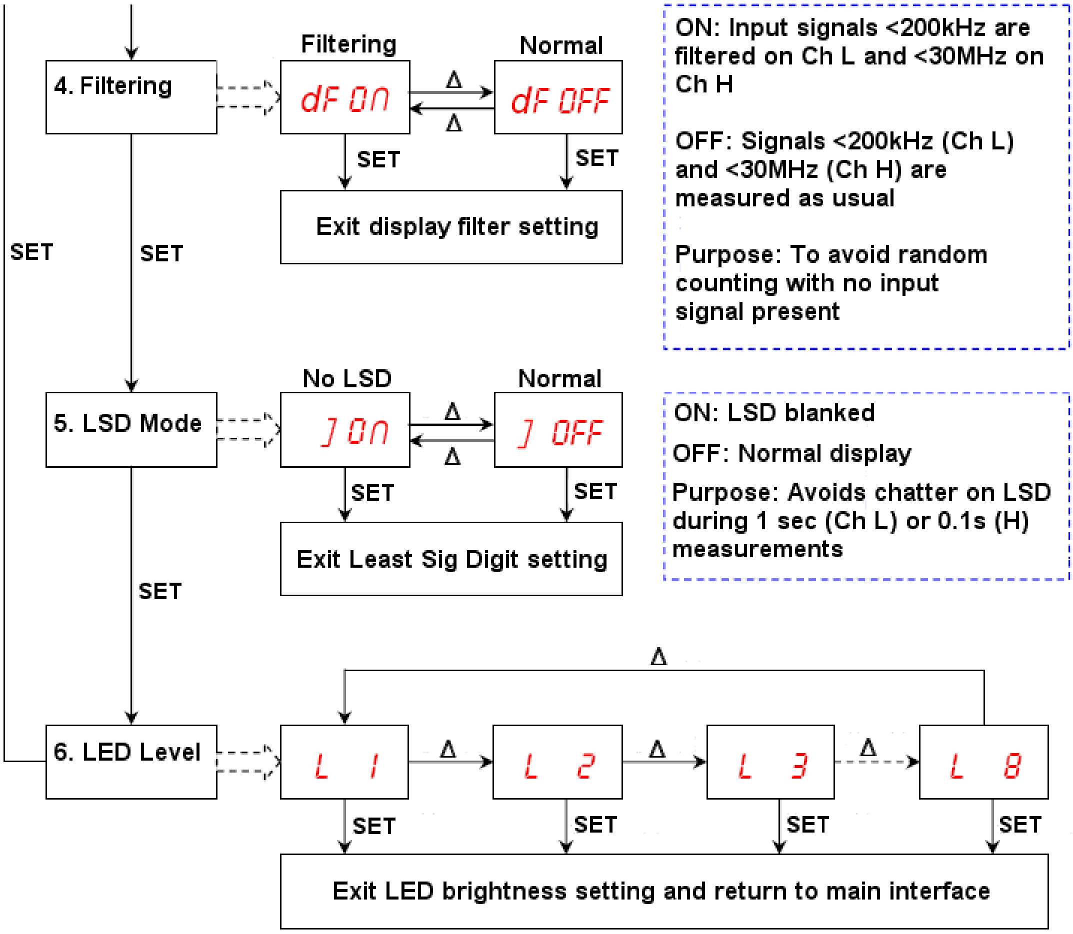
(B) MENU STRUCTURE

SYSTEM SETTINGS

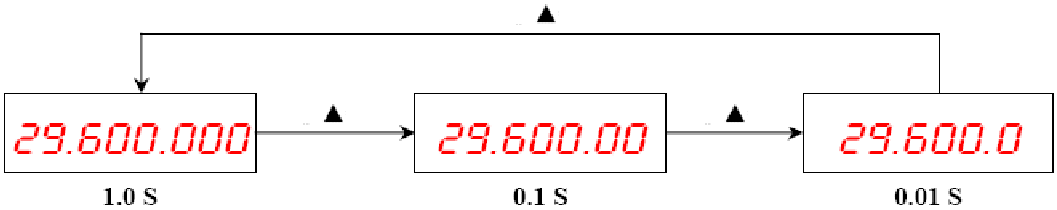
Red: display character

Blue: blinking character

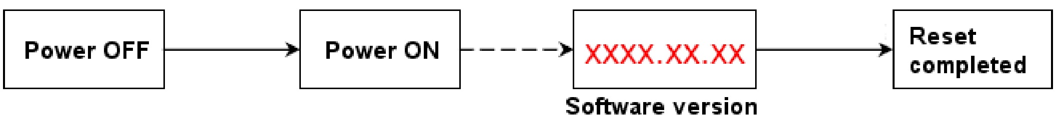




GATE TIME ADJUSTMENT



SYSTEM RESET



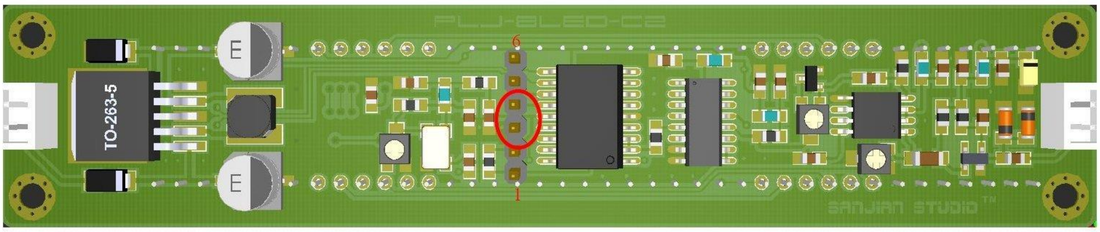
SELECTION OF IF FREQUENCY

One of two IF frequencies may be selected by using pin 4 of the ICSP programming interface. If pin 4 is pulled High or left floating, then the first IF frequency is used. If pin 4 is pulled to ground, then the second IF frequency is selected.

Each IF frequency can be independently programmed with IF frequency and offset (Add or subtract). The first IF settings are programmed when pin 4 is pulled High or left floating, and. the second IF settings are programmed when pin 4 is pulled to ground.

The default factory programming sets the floating pin 4 as the first IF configuration. If the IF is zero, then the Up/Down setting is ignored.

In practice, pin 3 (GND) and pin 4 of the ICSP programming interface ICSP can be connected to a 2P DuPont connector immediately adjacent or on the pins (See location circled in red below). A switch can then be connected to select the appropriate IF setting.



ICSP：

Pin	1	2	3	4	5	6
Function	VPP	5V	GND	PGD/IF SELECT	PGC	AUX

(C) MEASURING FREQUENCIES

The signal to be measured should be connected to the RF IN (signal input) port. This signal input can be connected to the local oscillator output from a transceiver or to other test points. Once connected, the LED display will show the frequency in real time.

The high-impedance input design helps to reduce the load of the counter on the local oscillator circuit in the transceiver LO. However, the signal being measured should be greater than 60mVpp. For example, the oscillator signal from the widely used NE602 / NE612 is weak and the counter may not be able to obtain a stable frequency value.

PRODUCT ORDERING

To facilitate the use of test equipment, Sanjian Studios can supply small quantities for personal purchases. Agents should go to the main page of the Taobao search engine and search for "Sanjian Studio" or "PLJ-8LED" or they can also directly contact the company.

The product packaging bag is sealed with a label containing a two-dimensional barcode. This may be scanned to load a web address to obtain product-related technical support.

PRODUCT DETAILS:

- IC devices installed
- Reflow process used
- Uses double sided plated through nickel-plated copper PCB
- No power supply, no enclosure
- Fully tested

PACKING LIST:

- PLJ-8LED-C module (in anti-static bag) 1 off
- XH2.54-2P 20cm long cable 2 off

PRECAUTIONS:

- Two XH2.54-2P 20cm cables are included in the package. Please note the color polarity and connect correctly. Check the wiring polarity of the socket assembly before applying power, and read the manual before using the module to understand its operation.
- Do not place the instrument in hot, humid, or dusty environments, and mountings should prevent severe vibration.
- After module manufacturing, the reference frequency oscillator was aligned using a rubidium reference. The sensitivity adjustment has been optimized so do not adjust unless necessary.
- Under normal usage, the module is covered by a warranty period of six months. Warranty does not apply if subjected to incorrect use, modifications, or operated under abnormal conditions which may lead to the destruction of the product.

FAQ

1. Will the frequency counter generate any interference when installed in a transceiver?

Zero interference is impossible because the microcontroller, crystal and LED driver all produce some radiated RF noise, but the level is quite low. Some measures have been taken in the design of the module to keep certain components away from the transceiver. If interference is encountered, try changing the position of the module or install a shield.

2. What is the reason for frequency display instability?

First, make sure the quality (strength, stability, etc.) of the input signal meets the minimum requirements of the module (see Technical Data section). The input cable connecting to the signal should use shielded wire, and the power supply should also be suitable. Check it has no noise or ripple.

3. Why is the display showing values when there is no input signal?

Check if the ripple on the power supply being used with the module is too large, then check whether if something near the module is generating a strong signal. The module can reject invalid signals by using signal filtering. On the low range (CH L), filtering removes invalid signals below 50kHz, and below 20MHz on the high range (CH H). This will then result in the normal display showing zero with no input signal.

4. Since the display is limited to eight digits, how can it display the “hundreds of megahertz” and gigahertz digits with 0.1s and 1s gate times?

By reducing the gate time or using the LSD function, it is possible to obtain a suitable frequency display.

For example, when measuring 450.000 000 MHz signal:

When the LSD is OFF (See Menu setup section above)

- 1S gate display: 50.000.000
- 0.1S gate display: 450.000.00

When the LSD is ON

- 1S gate display: 450.000.00
- 0.1S gate display: 450.000.0

When measuring a 2400.000 000 MHz signal:

When the LSD is OFF

- 1S gate display: 00.000.000
- 0.1S gate display: 400.000.00

When the LSD is ON

- 1S gate display: 400.000.00
- 0.1S gate display: 2400.000.0

DIY OPTIONS

A full set of manufacturing information on the PLJ-8LED-C was released on a forum which can be sent directly to a PCB Gerber file processing plant. The software is also available (as a HEX file) suitable for most microprocessor programmers without manual intervention. If your programmer doesn't recognize the settings, the crystal type can be selected and the remaining options simply turned off. (Note: Sites appear to require registration)

A summary of all the conditions covering this software and which limits its use are found in the programming document released by the Forum. When you power on the 25th time, the counter will display "--------". To remove these restrictions and continue to use the counter, carry out a system reset to recover (Press and hold the SET key during boot up). There are no other hardware or software traps.

Attachments containing the frequency meter data for previous releases can be found on the **hellocq.net** forum, as follows:

2008-11-03 ： http://www.hellocq.net/forum/read.php?tid=189583

2008-11-04 ： http://www.hellocq.net/forum/read.php?tid=189696

2008-11-05 ： http://www.hellocq.net/forum/read.php?tid=189718

2009-03-30 ： http://www.hellocq.net/forum/read.php?tid=200868

2011-04-27 ： http://www.hellocq.net/forum/read.php?tid=264417

2011-12-14 ： http://www.hellocq.net/forum/read.php?tid=282626

2013-03-22 ： http://www.hellocq.net/forum/read.php?tid=312288

Note: Additional details and the following appendix have been added to this translation from various sources and attributed where the source is known.

APPENDIX : TESTING AND MODIFICATIONS

1. ACCURACY

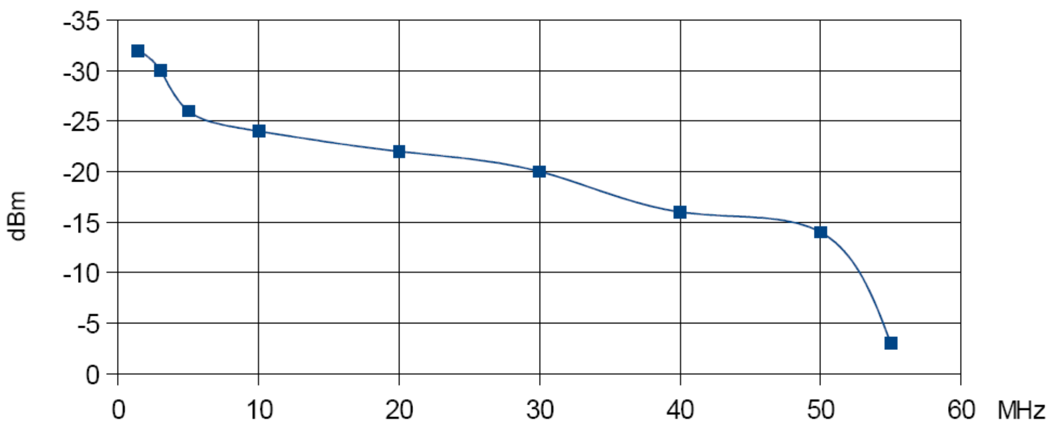
The accuracy of the measured frequency was tested by F6CQK using an EPOC quartz oscillator calibrated from a rubidium clock. This showed an error of -10 Hz. This was easily corrected using the calibration adjustment available near the TCXO.

A measurement over 24 hours shows a stability better than 1 Hz.

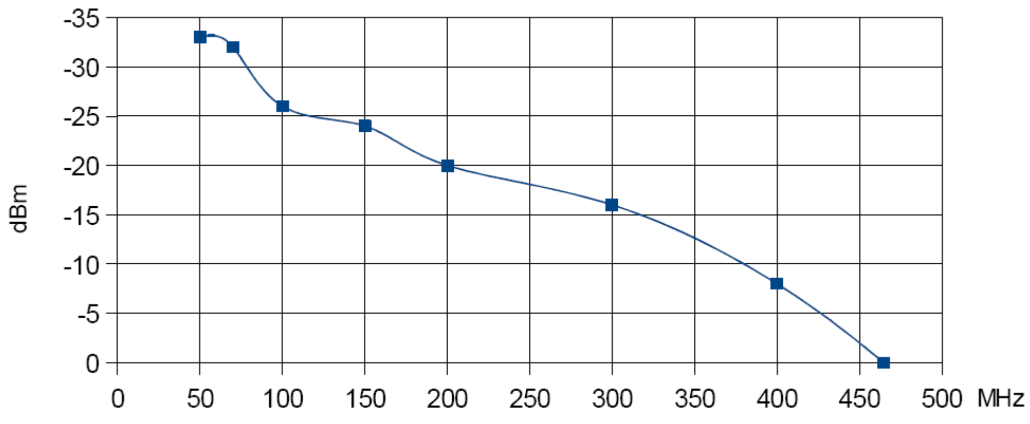
2. SENSITIVITY

The sensitivity of the module was measured by F6KEH, shown below:

Low Channel (CH L)



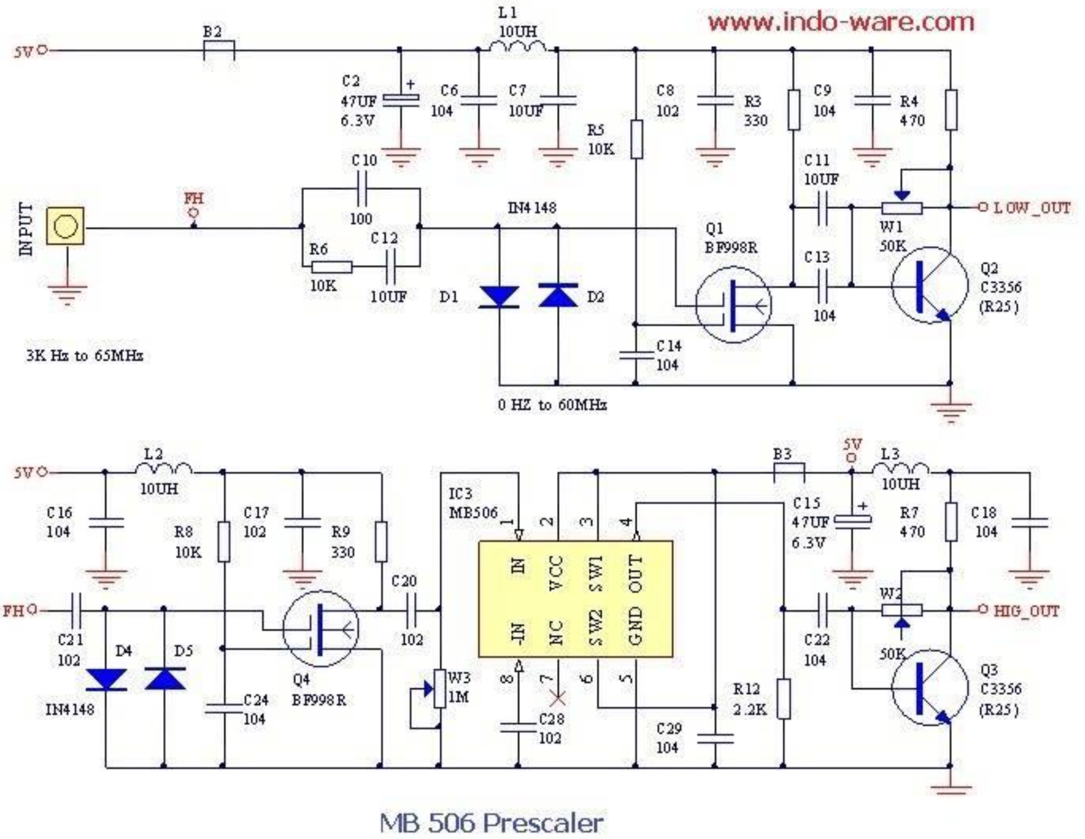
High Channel (CH H)



3. SCHEMATIC AND MODIFICATIONS

It is noted that the UHF channel allows measurements up to about 450 MHz. This path comprises a divide by 64 stage claimed to be able to operate to 2.4GHz according to the published specifications. It is therefore surprising that the sensitivity fell as quickly as it did. The problem could come from the automatic channel switching. Unfortunately no schematic is provided in the Chinese instructions.

However, elsewhere, a circuit for the front end was located:



This shows a conventional preamplifier for each channel paralleled at the input, each channel using a dual gate MOSFET as a preamplifier followed by a buffer stage (CH L) or divider/buffer (CH H). The buffer transistors in each channel are used to obtain a TTL level. This somewhat “agricultural” approach suggests that the low channel is likely to be excessively loading the higher channel, and that is precisely what we see in the French sensitivity results.

The ideal solution to this is to separate out the two inputs and connect them to two separate input connectors, one for each channel.

Note: The High channel (including prescaler) is located on the visible side of the PCB adjacent to the PIC microprocessor and the TM1639 LED display driver. The Low channel is not visible. It is located under the left hand front panel LED display (when the module is viewed from the front) and is connected to the input connector and microcontroller via through-plated holes in the PCB.

4. CHANNEL SWITCHING RELIABILITY

The manual notes (See above) that the automatic channel switching does not always work reliably for low frequencies above 30 MHz. In this case it is best to manually select the range.

For frequencies above 100 MHz, the hundreds digit may not be displayed sometimes. In this case, press the Δ button to select the appropriate gate time until the hundreds digit is displayed.